

up and disintegrating under the influence of the air and waves; it is fissured through and through, a large portion has already fallen away, exposing terraces of blue ice previously submerged, and the sea around is cumbered with the fragments. It is easy to see how almost any eccentricity of form may be produced by the irregular action of the waves upon the different sides of an iceberg tilted to different inclinations.

When an accidental hollow or other irregularity on the surface of an iceberg directs the action of the surf on any special point, a cave is speedily formed, and the effect constantly increasing with the deepening of the cavity, the ice is often honeycombed with caverns which penetrate far into the solid berg, and add wonderfully to its beauty by their lovely colouring in shades of cobalt blue, varying with every play of shade and light. The caves are, however, very fatal to the iceberg. From the ice not being thoroughly rigid, whenever the support is taken away from beneath, the layers above bend and give way; vertical fissures are produced which become filled with a breccia of ice and snow, often discoloured by sea-birds; the ice, instead of showing its original uniform horizontal stratification, is distorted into all sorts of anticlinals and synclinals; and fragment after fragment crashes down into the sea.

Fig. 2 gives an idea of the form of a beautiful vaulted berg. The sea was washing through and through it; and as we passed close by, we sat gazing, entranced, at the marvellous beauty of the colouring of the vaults of ice, and the waves, and the snowy spray illuminated by a red setting sun; but our gorgeous iceberg was evidently doomed to speedy destruction. Some glittering pinnacles were the only remains of the buttresses of former arches, and a quantity of *débris* floating round it showed that the whole fabric was undergoing rapid change.

Some few of the bergs which we saw were tilted up to an angle of upwards of 50°, and in various ways—by the inclination of the bergs, by the denudation of successive layers by the action of the sea, and by “dislocations of strata.” I believe we saw at various times sections of icebergs to the depth of perhaps 400 feet. All such sections gave simply a continuation of the same phenomenon which we observed in the portion of the berg normally exposed, a gradual approximation of the lines of stratification and deepening of the blue colour.

Sometimes we saw small bergs which were very irregular in form, with all marked prominences rounded off, perfectly clear, and of a deep sapphire blue. These I conceive to be masses of ice from near the base of a berg, which, from extreme shifting of its centre of weight, has turned right over, and exposed the ice near the bottom, in which, by melting and regelation under great pressure, all structure has been lost.

The curious question naturally arises, Shall we ever be able to reach the South Pole? With our present methods and appliances I should think that the answer must be an unhesitating negative. Except possibly somewhere in the region where Ross penetrated, in 1842, to the parallel of 78° to the south of New Zealand, or about Graham Land, where Capt. Dallman, in 1873, continued the explorations of Capt. Biscoe, there seems to be no accessible lead of land; and Ross's southernmost point is upwards of 700, and Graham Land 1,200 miles from the pole. The remainder of the outline of the Antarctic continent appears to be a perpendicular cliff 200 to 250 feet in height, without shelter, and with a heavy pack broken up and kept in motion by frequent gales moving outside it during the greater part of the year, and bounding a vast expanse of glacier surface, a great part of it subject probably to high winds and to almost incessant falls of snow.

We have now learned that the North Pole, if not actually inaccessible, is much more difficult of access than we imagined, even with the long roll before us of the

gallant men who have strained through many years the resources of human skill and bravery to the utmost in fruitless attempts to attain the barren issue; and we can only anticipate disasters multiplied a hundred-fold should the South Pole ever become a goal of rivalry among the nations.

C. WYVILLE THOMSON

NORDENSKJÖLD'S EXPEDITION TO THE JENISSEI¹

THE expedition, of whose plan, equipment, and composition we have already given some account, left Tromsø in the steamer *Ymer*, on July 25 this year, and on the 30th entered Matotschkin Scharr, where they obtained some specimens of Novaya Zemlya salmon. An easy passage was made to the east side, where, during a stay of twenty-four hours, the naturalists did some collecting, dredging, &c. Leaving the Scharr on the 31st, the Kara Sea was at first found quite open, but after a few hours it became so blocked with loose ice in all directions that the *Ymer* was compelled to turn back, and was anchored on the inner side of the promontory which projects from the southern side of the sound, nearly half way between the entrance and Gubin Bay.

Here the sea is rich in varying animal forms, the land bleak and poverty-stricken. The mountains for the most part consist of black clay-slates, probably early Silurian, and grey dolomite beds, in which search was made for fossils in vain. On the other hand, the clay-slate is in many places full of quartz veins with numerous cavities, whose crystalline contents gave occasion to the unfortunate Tschirakin's statement that he had found here a block of stone set full with the most brilliant, beautiful, and valuable precious stones, for which, after his death, he was vehemently censured by his chief, Rossmaylov, who sought in vain for the supposed treasure.

In one respect this part of Novaya Zemlya is of great geological interest; for here are to be seen no fewer than six clearly-marked beaches, situated at different heights one above the other, and showing that the land hereabouts has been elevated during the very latest geological period at least 500 feet. With the exception of certain parts of Greenland, where a considerable sinking of the land has taken place during recent centuries, a similar raising of the land has been observed in most other Arctic regions, and this raising of the land has without doubt played a very important part in the great geological changes which have occurred on the surface of the earth since the close of the Tertiary period. For the Swedish observer the phenomenon besides has quite a special interest, inasmuch as attention was first called to it in Sweden more than a century ago, and it then gave occasion to an impassioned discussion between those holding different opinions, which is well known in the history of science.

Matotschkin is surrounded by high, bold mountain ridges and summits, which continue to occupy the interior of the island for more than thirty English miles south of the sound. Farther south the mountain tops disappear completely from the interior, and the land passes into a level high-lying plain, nearly free of snow during summer and sloping gently towards the east coast and the Kara Gate, till it terminates most frequently with a precipitous face towards the sea.

A broad ice-free belt of water having in the meantime been formed along the east coast of Novaya Zemlya, the expedition took advantage of it, and sailed along shore. The greater part of the ice-fields were, however, now quite rotten, and it was clear that they would completely melt away during the remaining part of the summer.

Partly by ice, partly by fog, the *Ymer* was prevented making right across the sea, and it was not till the 12th that the ice-belt was so broken up that they could steam on round White Island, past the Gulf of Obi to the mouth of the Jenissei.

We sighted land here on the 15th, Dr. Nordenskjöld goes on to state, thus exactly a year after the rocks at Dickson's Harbour were first seen from the *Prøven*. This was some hours sooner than the dead reckoning promised, which at first was ascribed to the influence of an easterly current in the parts of the Kara Sea we had just traversed. When we came nearer, however, I was surprised to see before me a plain which was unbroken by any “berg-åsar,” though I knew, from last year's observation, that

¹ Abstract of Prof. Nordenskjöld's Report in the *Göteborgs Handels- och Sjöfartstidning*, October 24.

an "äs," which was certainly low, but yet perfectly developed, runs over the tundra towards Jewremow Kamen; neither could we discover any of the rocky islands which surround Dickson's Harbour. In the meantime we continued our course up the river along the bank, and after the lapse of four or five hours we obtained a quite unexpected explanation of the circumstances described. For it appeared that the mouth of Jenissei, which is ten Swedish miles (60') wide, is divided into two by an island about five Swedish miles (30') long, which was thought to have been unknown both to Russian cartographers and to the natives. That it has not been before observed clearly depends on its not being visible from the river bank along which the few boats that have traversed this part of the river are believed to have always kept. The navigable water on both sides is deep and free from shallows. This large new island ought clearly to be advantageous for navigation in those regions, as it will form a welcome protection against north-westerly winds and sea for the vessels that may be in the mouth of the river. I mean to name it Sibiriakoff's Island, after the zealous and generous supporter of all this year's Siberian expeditions.

Steaming up the river the *Ymer* reached Mesenkin, which had been appointed the meeting-place with Dr. Théel's party. Here, where the Mesenkin falls into the Jenissei, Dr. Théel expected to obtain some specimens of mammoth skins, which, it was reported, had been washed out of the tundra near this place. Dr. Théel's party, not, however, having arrived at Mesenkin when the *Ymer* reached it, Nordenskjöld himself made an excursion to the locality already spoken of, where the mammoth hide was found. No complete hide was found here, but he succeeded in digging two large and a number of small pieces out of a newly-formed sand-bank at the confluence of the Mesenkin with the Jenissei. The excavations showed that the mammoth remains in question had been newly brought down by the spring floods to the place where they were found from some point situated higher up in the river valley of the Mesenkin, and that the place where the mammoth was originally imbedded in the frozen tundra is to be sought for in this direction.

On August 17 the *Ymer* proceeded up the river, but the water became so shallow, and the navigation by a steamer of such draught as the *Ymer* so dangerous, that Dr. Nordenskjöld resolved to return to Mesenkin. He left his merchandise at Korepowskoj simovie, near Mesenkin, to be taken away next summer by the river steamer. After landing the goods another vain attempt was made to steam up the river, and the *Ymer* was again anchored, this time between Orlowskoj and Gostinoj. The following days were devoted to excursions which yielded interesting information regarding the geology of the tundra, and a very rich collection of the sub-fossil shells, which are found in the sand of the tundra.

By the word *tundra* are denoted, as is well known, the plains of immense extent in Russia and Siberia lying between the boundary of the forest region and the Polar Sea. The ground, at least in the northern parts of the Siberian tundra, is continually frozen at no great depth, but during the summer bears a vegetation of low bushes, mosses, and grass, which yields summer pasture to numerous herds of reindeer, partly wild, partly tame, which wander about on them.

To the eastward of the Jenissei the tundra forms a level or slightly rolling plain, which toward the river has a sloping bank 50 to 100 feet high. In the interior of the country the plain is not interrupted by any very considerable heights, but on the other hand it is intersected at a number of places by deep river valleys, whose steep sides offer fine sections of the earthy layers. It is apparent, on a merely cursory examination, that these for the most part consist of enormous masses of sand and mud washed down by the Siberian rivers. The tundra, however, is by no means a common delta formation. Numerous marine shells imbedded in the sand show that the tundra plain formerly lay under the surface of the sea, and that therefore a considerable elevation of the land must have taken place during the latest geological period. For all the shells imbedded in the tundra sand belong to existing types, the most of which have been dredged up by us from the bottom of the Kara Sea, and which we again find in the post-glacial beds at Uddevalla and Christiana Fjord, and the crag formation of England. All this shows that the tundra has been formed under climatic circumstances very similar to the present, which is further confirmed by the geognostic formation of the beds. It has therefore long been difficult of explanation by the geologist that just in these sand-beds there are found in great abundance remains of the mammoth, rhinoceros, &c., that is to say, of animal types that

for the present flourish only in a tropical or sub-tropical climate.¹ The evident contradiction which is apparent here has indeed obtained an explanation through the researches of the Petersburg academicians, Middendorff, Schmidt, and Brandt. But there remains here much to clear up, and collections from these regions have, besides, a peculiar interest, from the remarkable circumstance that here in the frozen earth of the tundra there are found not only skeletons, but also flesh, hides, hair, and intestines of animal types which died out many hundred thousand years ago. I therefore, Dr. Nordenskjöld goes on to say, of course, gladly availed myself of the opportunities which offered themselves in making excursions in the neighbourhood of the places where the vessel was anchored. Among the results of our search may be mentioned large pieces of mammoth hide, found along with some few pieces of bone, at the confluence of Mesenkin with the Jenissei; a skull of the musk ox, remarkable for its size, found together with mammoth bones in another tundra valley south of Orlowskoj; a very rich collection of sub-fossil shells, found principally between Orlowskoj and Gostinoj. In addition, various interesting observations concerning the geological formation of the tundra, &c., were made.

During their stay on the Jenissei there was often a dense mist with rain prevailing, but otherwise they were favoured, as a table of observations shows, with warm and summer-like weather. The ground was quite free of snow, and at several places, especially in the tundra valleys, adorned with a variegated carpet of flowers. According to the statement of the inhabitants, however, the former part of the summer in these regions had not been fine, and the preceding winter had been exceedingly severe. The temperature of the water of the river at the surface was almost constantly + 12° to 13° C., and even at a depth of nine fathoms the deep-water thermometer marked + 11.1° C.

As it had been arranged that Théel's party, which, as our readers know, had come overland, should in no case stay so long on the northern part of the Jenissei as to run the risk of missing the last river steamer to Jenisseisk, which this year was to leave Saostrowskoj about September 7, Nordenskjöld resolved to set out on the return journey on September 1. This he did, as Théel's party had not turned up.

The sea, he continues, was at first completely free of ice, and first when we came quite close to the east coast of Novaya Zemlya in 75° N. lat., a very compact belt of worn ice was fallen in with, which stretched along the coast towards Matotschkin. The course was now set along the ice towards the south to 74° 40' N. lat., where the edge of the ice took a westerly direction, which allowed us, without the inconvenience of being hindered by ice, to steam right westwards towards Matotschkin. A perceptible swell now gave indication of ice-free water. If the course from Dickson's Harbour had been set close past White Island towards Matotschkin we certainly would not have met with a single ice-floe. Even in the northerly way I chose our advance was scarcely hindered by ice but by a nearly constant fog, which compelled us to lie still at night. In this way Dr. Stuxberg, the zoologist of the expedition, obtained a welcome opportunity for dredging and swabbing in the deep channel along the east coast of Novaya Zemlya.

Of all the expeditions which have gone to Novaya Zemlya and the sea surrounding it, there are only three which, before the last two Swedish ones, concerned themselves with zoological, botanical, and geological researches and the collections pertaining to them. These are von Baer's expedition in 1837, Heuglin's in 1871, and the Austro-Hungarian in 1872-74.

As far as zoology is concerned, von Baer brought home from his journey about seventy species of invertebrate animals, Heuglin increased our knowledge of the number of species within some groups, and the Austro-Hungarian expedition within others. But all those collections were from the south-western, western, and northern coasts of Novaya Zemlya. Of the nature of the animal life in the Kara Sea all actual knowledge was wanting till last summer. There was also a current tradition among zoologists, grounded on the knowledge of the immense mass of fresh water which the Obi and the Jenissei yearly carry down, partly also on something at first loosely uttered in literature, which afterwards took the form of axiomatic certainty, that the Kara Sea is exceedingly poor in animals.

The Swedish expedition of 1875 has already dissipated these misconceptions, having brought home from Novaya Zemlya and

¹ The mammoth, for instance, is looked upon as the progenitor of the now living Indian elephant, but a progenitor considerably larger than his descendant, and provided with an abundant covering of hair.

the west coast of Waygats Island a collection many times richer in species than its predecessors. But in any case it was impossible that the collections which were made during a single summer could be taken as giving so complete an idea of animal life in these regions, as is necessary not only for comparison with the existing fauna of other arctic countries, but also for a complete clearing up of its relation to the fauna in the deposits of the Siberian tundra. It was on this account that I made provision for Dr. Stuxberg accompanying this summer's expedition to Jenissej, and carrying on the zoological work. His researches were rewarded with great success, as appears from the short sketch annexed, communicated by him:—

"During the voyages of 1875 and 1876 to Jenissei and back dredging has been carried on at fifty places in all and at different depths from the beach to a depth of 200 fathoms, and rich and comprehensive animal collections have thus been made. A large proportion of species occur locally, and in quite incredible numbers. Others again are found nearly at every dredging, but in far smaller numbers. The occurrence of the latter is more uniform, consequently distinctive of the territory of the fauna in its entirety. To these belong first of all two species of the genus *Idothea* (*Id. sabinei* and *Id. entomon*), both well-developed, and it may with reason be said that this genus is characteristic of the Kara Sea; it is the province of the *Idothea*. To the animal forms again which are local in their occurrence belong various species of Mollusca, Hydromedusæ, and Bryozoa, but chiefly all the representatives of the Echinodermata are known to exist here. The abundance of these is sometimes quite surprising, and, what is more singular, where a species occurs in any great quantity, it lives nearly alone, and to the exclusion of all others. This, for instance, is the case with species of the genera *Cribella*, *Stichaster*, *Ctenodiscus*, &c., which here are found in large and well-developed types. Not seldom the swab brought up at the same time hundreds of the same species. Of the beautiful Crinoid *Alecto Eschrichtii* there were obtained many choice specimens.

"But rich as is the Kara Sea in asterids and ophiurids, it is proportionately poor in echini. These have been sought for everywhere without success, except possibly close to the east coast of Novaya Zemlya. This circumstance is the more extraordinary as along the whole of the west coast a species of the family *Echinus* is one of the animal forms that are most abundant and occur most frequently.

"In two respects the zoological work of this summer has been exceedingly profitable for our museums. It has in the first place added something new in all the groups to the very rich collections made during last summer; it has, for instance, increased the collection of crustacea by 20 per cent. new species, and of echinodermata a large number of types has by oft-repeated swabbing been obtained in an extraordinary collection of specimens. Further, the swab has brought up from the bottom of the Kara Sea two animals specially remarkable and important in a systematic respect. The first was brought up by the swab during last year's expedition, not far from the eastern mouth of Matotschkin Scharr. Then it was found in only a few specimens, now we have collected a considerable number. It is a hitherto unknown holothurioid, differing greatly from most others of the same group by its quite complete bilateral symmetry, but from all by its habitus and anatomical structure, and being singular in its kind inasmuch as it combines characters from diverse classes of animals. It has lately been exhaustively described and delineated in detail by its first discoverer, Dr. Théel. The other remarkable animal is one of the greatest rarities within the animal world. It is an *Umbellularia*¹ of about a foot and a half in length. It

was found in 150 fathoms south of Cape Middendorff, and north of the 75th degree of N. lat.

"From the collections made during the Swedish expeditions it appears that the Kara Sea, far from being so poor as has been supposed, is, on the contrary, distinguished by an animal life rich both in individuals and in types when compared with that which Spitzbergen, Greenland, Iceland, and the Arctic regions of North America have to show. It appears, also, that a nearly uniform marine fauna is found around the pole along the whole coast of Siberia and the polar archipelago of North America. The immense mass of fresh-water which the great rivers of Siberia carry down, does not in any degree determine the composition of the animal life on the bottom of its Arctic Ocean.

"Before the various groups have been worked out by specialists it is difficult to state for certain the number of the lower animal types of the Kara Sea, but it may be put approximately at nearly 500 species, a considerable number, indeed, for a sea that previously was believed to be as poor in species as the Baltic. Such, with the addition of about a hundred species of insects from Novaya Zemlya, whence previously only seven were known, and an extended knowledge of the vertebrate world, is the main zoological result of the researches of the last two Swedish expeditions in these regions."

The *Ymer* made a safe return voyage through Matotschkin Scharr, and on September 18 anchored at Hammerfest. Dr. Nordenskjöld concludes:—

"My stay at Hammerfest and Tromsø I turned to account in collecting information from the numerous walrus-hunters there about the state of the ice in the Arctic regions, and especially in the Kara Sea. I have succeeded in this way in bringing together very abundant materials for a solution, founded on actual observations, of the problem in navigation which lies before us here, and I shall, by and by, make a full statement of the conclusions at which I have thus arrived. Here I will only say that it is my conviction, which is also shared by the walrus-hunters whom I have consulted, that a regular sea-communication between Siberia and Northern Europe during a short season of the year ought not to be attended with greater risks and dangers than seamen encounter on many other waters now yearly visited by thousands of vessels."

OUR ASTRONOMICAL COLUMN

TELESCOPIC METEORS.—In his "Histoire de l'Astronomie pour l'Année VIII.," Lalande, referring to Schröter's observations, states, "il a vu plusieurs fois dans son telescope des petites étoiles qui filent comme un petit trait de lumière très-faible, qui dure 2 ou 3^s," and by way of explanation goes on to say that this proves the extension of hydrogen and oxygen many leagues in the depth of the atmosphere; meteors or globes of fire which excite astonishment when they are at a distance of some hundred *toises*, become shooting stars when they are distant a league, and telescopic stars at three or four leagues, an opinion hardly favoured by later research.

When occupied in comet-sweeping, or general observation in a dark and pretty large field, it has very often occurred to the writer to meet with objects of the class mentioned by Lalande. A striking instance was afforded one very fine April morning about twenty-seven years since (the exact date, though upon record is not at hand at this moment), when a number of telescopic meteors as bright as stars of the eleventh magnitude passed slowly through the field at intervals of a minute or more, the instrument during the time of observation being directed to different parts of the constellation Sagittarius and lower region of Ophiuchus; the course of these meteors was nearly uniform. Their motion was generally so slow that when caught they could be followed to extinction on moving the instrument. On other occasions he had noticed similar slow-moving meteors, though in less number, and hence was under the impression that there was nothing unusual in the occurrence. But in the summer of 1850, happening to mention the observations of frequent faint slow-moving telescopic meteors to Sir John Herschel, that eminent observer, notwithstanding his long experience in both

¹ Two specimens of the family *Umbellularia*, the first of which we have any knowledge, are said to have been found on the coast of Greenland before the middle of last century. After a description first given by Ellis and Mylius, the animal was registered by Linnæus in his "Systema Naturæ," in the year 1758, under the name *Isis encrinurus*. What has become of the original specimen is unknown. The enigmatical animal type, as it appeared from the descriptions, has been the subject of many interpretations, till Dr. J. Lindahl, during the Swedish expedition to Greenland in 1871, succeeded in dredging up two specimens of it in Baffin's Bay, and accurately described its interior structure in the *Transactions* of the Academy of Sciences. Individuals of the same genus have since been found, first by the English *Challenger* Expedition in 1873, between Portugal and Madeira, by the same expedition between Prince Edward's Island and Kerguelen's Land, and possibly at other places in the Antarctic Ocean; afterwards by the Austro-Hungarian expedition in 1873, between Novaya Zemlya and Franz Josef Land (the specimen was lost when the *Tegetthoff* was abandoned); again during the present summer by the Norwegian Atlantic expedition off the west coast of Norway, and finally by us in the Kara Sea. It is thus an animal type which is widely distributed, but of extremely rare occurrence.